Bache (J)

PROFESSOR BACHE'S

INTRODUCTORY LECTURE,

DELIVERED IN

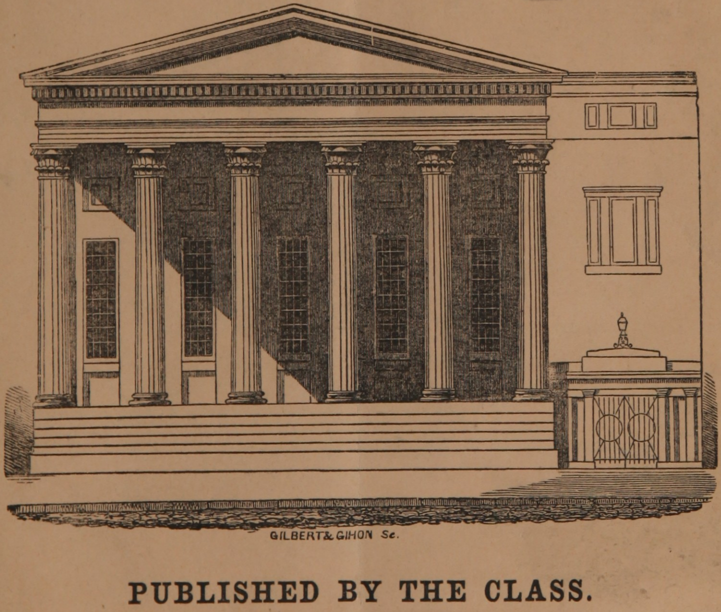
JEFFERSON MEDICAL COLLEGE

OF

PHILADELPHIA,

2

October 13th, 1852.



GILBERT & GIHON Sc.

PUBLISHED BY THE CLASS.

Bache (Fr.)

INTRODUCTORY LECTURE

TO THE

COURSE OF CHEMISTRY,

DELIVERED IN

JEFFERSON MEDICAL COLLEGE,

October 13th, 1852.

BY

FRANKLIN BACHE, M.D.

2

PUBLISHED BY THE CLASS.

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1852.

CORRESPONDENCE.

Philadelphia, *Oct.* 26, 1852.

Sir,—Appointed to address you by the Class of the Jefferson Medical College, we most respectfully solicit for publication, a copy of your Introductory Lecture, delivered at the commencement of the present session.

With the highest respect, we remain your obedient servants,

R. W. Richie, M. D., *Ohio, Pres't.*
Ellery P. Smith, *N. Y., Sec.*
Thos. H. Burnell, *England, Treas.*
George F. Jackson, *Maine.*
S. Randolph Merrill, *N. H.*
E. H. Brinley, *Connecticut.*
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Andrew J. Stoner, *Illinois.*
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Samuel M. Axford, *Michigan.*
James P. Earickson, *Missouri.*
Jos. R. Brown, M. D., *Texas.*
Michael Lavell, *Canada.*
Wm. F. Humphrey, *New Brunswick.*
James L. Chipman, *Nova Scotia.*
John W. Norris, *Newfoundland.*
E. A. Czapkay, *Hungary.*
Wm. Goodell, Jr., *Turkey.*
Joaquin Plana, *Cuba.*

To Franklin Bache, M. D.

Philadelphia, *November*, 4, 1852.

Gentlemen,—I have received your note, in which you do me the favour to ask a copy of my Introductory Lecture, delivered on the 13th ultimo, for publication. Thanking you for this mark of your regard, I comply with your request, and put the manuscript at your disposal.

With kind wishes for yourselves, and for those you represent,

I remain your sincere friend,

FRANKLIN BACHE.

To Messrs. R. W. Richie, *President*, Ellery P. Smith, *Secretary*, Thos. W. Burnell, *Treasurer*, and others, *Committee of the Class of Jefferson Medical College.*

INTRODUCTORY.

It is with no ordinary feelings, gentlemen, that I receive your cordial greetings. I know that they proceed from warm and generous hearts; and I should be unworthy of your esteem, were it possible for me to stand here unmoved. The occasion makes me revert to the time, now thirty years ago, when I made my first essay as a chemical teacher, and lectured to a private class of but six pupils, under the auspices of a valued and generous friend, now no more.* Little did I then think that the future honour was reserved for me of addressing some of the largest medical classes that have ever assembled in our wide-extended country.

My duty in the chair which I have the honour to hold in this College, is to teach chemistry as applied to medicine. In performing this duty, it is necessary to teach the principles of chemistry; for, without these, its applications could not be understood. Accordingly, I shall feel myself justified in presenting a systematic view of the fundamental doctrines of the science, dwelling upon those parts which have medical applications, and treating the remainder with comparative brevity.

When we reflect that the province of the medical man is to preserve and restore health; and that, to accomplish these objects, he operates upon matter, possessing vital properties, by means of inorganic matter, which constitutes nearly all our remedies, we cannot fail to be struck with the paramount importance of studying the properties of material substances. Matter, considered even in its mechanical relations, deserves to be carefully

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* Dr. Thomas T. Hewson.

studied by the physician; for the human frame is subjected necessarily to the law of gravitation; and the various parts of its mechanism illustrate, more or less completely, the different mechanical powers. But it is in its chemical relations that matter especially concerns the medical man; for chemistry may be considered to form a kind of minute anatomy of matter, teaching us the mutual influence of its smallest parts; and it should be borne in mind, that the action and forces of matter, in this relation, assimilate more nearly than in any other, to its action and forces when endowed with life.

Matter is divisible into two forms;—the ordinary form, which obeys the law of gravitation, and is recognised as matter by the mass of mankind; and the ethereal form, which is not obedient to this law, and, therefore, has no weight. The ethereal form of matter, called imponderable because devoid of weight, embraces four kinds; namely, light, heat, electricity, and magnetism. The ordinary form includes all material substances which have weight, and, of course, comprises the ponderable elements and their diversified compounds.

It is, indeed, true that some philosophers deny the existence of a form of matter that is imponderable. They conceive that if the law of gravitation be held as true of one form of matter, it must be true of all forms. Those who hold these views are driven to the necessity of considering all the effects, attributed to imponderable matter, to be, in fact, the effects of certain molecular motions, exhibited by matter which has weight. But it certainly is not essential to the existence of matter, that it should be actuated by the law of gravitation; for, if we accept the definition of matter that it is anything that occupies space, it is easy to conceive of its existence, without its parts having any tendency to come together. Is it, then, unreasonable to suppose that the Omnipotent Creative Power has endowed one kind of matter with the force of attraction, and withheld it from another kind, which seems rather to be actuated by the contrary force of repulsion? If the supposition of the existence of imponderable matter be rejected, we are forced to believe, that all the effects, attributed to distinct entities, called light, heat, electricity, and magnetism, are mere modes of action of ordinary matter; a belief which involves more assumptions, and is beset with more difficulties than that which holds these effects to be dependent upon four distinct imponderable fluids.

In this connexion, I may be permitted to allude to a speculation put forth, or rather revived, by Faraday, that we have no proof of the existence of matter as a distinct entity. Thus, he reasons that all the properties of what is called matter, may be explained by supposing the existence of certain points of force, around which the properties are arranged; and that, therefore, it is not necessary to assume the existence of any nucleus, in which the properties shall reside. Speculations of this kind, which require us to disregard the evidence of our senses, can be viewed in no other light than as learned trifling.

So far from wishing, with Faraday, to call in question the necessary existence of ordinary matter, I am disposed to believe, as the more probable conjecture, that even the causes of the phenomena of light, heat, electricity, and magnetism are material, though differing from ordinary matter in not having weight. The prevalent opinion is that the four classes of phenomena, just named, depend upon four distinct imponderable fluids; but there are not wanting plausible arguments in favour of the opinion that they all depend upon one and the same imponderable fluid. Thus, light is known frequently to accompany the three other imponderables. Heat is capable of exciting electricity, and hence we have the division of science called thermo-electricity; and, conversely, electricity evolves heat. Again, electricity and magnetism are so indissolubly connected, that we find it convenient to arrange the facts observed under separate divisions of science, called, severally, electro-magnetism and magneto-electricity. Finally, Faraday has shown that magnetism, by modifying the molecular structure of certain transparent bodies, is capable of impressing a change upon a ray of polarized light. If, in view of these and similar facts, the four classes of phenomena just named must be referred to one imponderable fluid, we may plausibly conjecture that the diversity of properties observed depends upon differences in its motion. Vibration or undulation may be assumed as its general mode of action. If the undulations have a certain velocity and amplitude, they may cause the fluid to present the phenomena of light; and by varying their velocity and amplitude in various modes and degrees, we may have the phenomena produced which we call heat, electricity, and magnetism. On the other hand, if the four classes of phenomena mentioned depend upon four distinct imponderable fluids, as we shall have occasion to teach as the more plausible theory, then the proneness of one class of the phenomena to give rise to the others may be explained on two assumptions; first, that all ponderable matter and all space contain the four imponderable fluids; and, secondly, that these have naturally an affinity for each other, which causes motion in any one of them to be propagated more or less to the others.

It is highly important that the physician should study the imponderables. They constitute, as we have assumed, four distinct forms of matter of extreme tenuity, which have an intimate though mysterious connexion with life. The importance of a knowledge of the properties of light, as bearing upon the physiology and pathology of the eye, needs no illustration; and the general influence of light, as a healthful stimulus, is admitted by every one. Heat is so indissolubly connected with life, that a certain deprivation of the former always destroys the latter. The physiology of animal heat cannot be explained without a constant appeal to the principles of the science of caloric. In that important class of diseases, fevers, a morbid extrication of heat is the most striking phenomenon. In therapeutics, caloric forms an important remedy; and the modes in which it should be added to the system as a stimulus, abstracted from it so as to produce a sedative effect, or equalized when found unduly distributed, form subjects of daily attention on the part of the medical practitioner. To deal, then, understandingly with this powerful agent, we must be acquainted with the laws which govern its absorption, extrication, and distribution; and possess, moreover, clear ideas of its relation to ponderable matter, as the cause of the liquid and aëriform states. Electricity and magnetism are likewise worthy of our study as therapeutic agents, and deserve more attention than has yet been bestowed on them by physicians. Their neglect in this point of view has probably arisen from the fact, that they are generally resorted to as remedies by ignorant persons, who apply them empirically. But this is not a sufficient reason why medical men should neglect the investigation of any agents, especially powerful agents, which are powerful for good or for evil, according as they are directed by science or by ignorance. Besides, the fact must not be lost sight of, that the force which is propagated through the nerves to the muscles, inducing muscular contraction, has its nearest analogy in the force of electricity; and it may not be too much to predict, that, if ever the mystery of nervous influence shall be explained, it will be by those physiologists who are most conversant with electrical science, and who have studied most successfully the relation of the electric force to muscular irritability.

The ponderable elements will be treated under the two classes of non-metallic and metallic. The non-metallic class comprises thirteen individuals, which constitute, in every point of view, the most important elements. Here we place first the gases, oxygen, hydrogen, and nitrogen, which deserve to be particularly studied, as forming the constituents of water and atmospheric air. In all treatises of chemistry, oxygen is placed first, on account of the universality of its affinities; there being but one element, namely, fluorine, with which it is not known to unite. The next elements I shall notice, form a group of volatile solids, namely, sulphur, selenium, and phosphorus. Sulphur is brought forward thus early, because it is the radical of sulphuric acid; and this acid, on account of its diversified applications, should be made known to the student as early as possible in the course. Next to sulphur, I find it expedient to notice selenium; an arrangement which enables me to render more clear the chemical analogies which these two bodies present, than if they were separated by the description of other elements. Phosphorus, being, like sulphur, a volatile solid, is placed very conveniently in this group. Next comes for consideration the very natural group, chlorine, iodine, bromine, and fluorine. These elements form acids with both oxygen and hydrogen, with the exception of fluorine, which forms an acid with hydrogen, but not with oxygen. The student is assisted in remembering the fact that these four elements are chemically analogous, by their names all terminating in the same syllable. Though chemically alike, they are, in physical properties, quite different.

Not to mention other physical differences, it is curious to remark that they furnish an illustration of the three states of aggregation; for while chlorine and fluorine are gaseous, bromine is liquid, and iodine solid. The non-metallic class will be completed by an account of carbon, boron, and silicon, three fixed solids, which form an interesting contrast with the three volatile solids, sulphur, selenium, and phosphorus, already referred to.

I shall early bring under your notice, gentlemen, the laws of chemical combination. It is found by experiment that the chemical elements unite in quantities by weight, which may be represented by a chain of numbers, each element having attached to it a separate number. These numbers represent the weights in which the elements to which they are attached, ordinarily combine with one another; and when there is a deviation from these numbers, the deviating element occurs in a quantity, which is an exact multiple of its appropriate combining number. As the different elements, when taken in the quantities represented by their several combining numbers, are capable of being substituted for each other in compounds, these quantities are held to be, in a chemical sense, of equal value; and, hence, the combining numbers themselves are called equivalent numbers, or equivalents. The principle of the equivalent numbers may be easily comprehended, by applying it to a small number of elements, as if no others existed. Thus, if *a*, *b*, and *c* be three elements, and we take a certain weight of *a*, and combine it successively with *b* and *c*, we get separate weights of *b* and *c*, representing the weights in which they combine with the given weight of *a*. Now, having got, in this manner, these separate weights of *b* and *c*, it is not necessary, as a general rule, to institute an experiment to ascertain in what proportion they will unite; for, the numbers obtained for them, deduced from *a*, represent, without further experiment, the ratio in which they combine with one another. Now, this reasoning applies not only to three elements, but to any number of elements that we may choose to assume.

The equivalent property of the combining numbers is, perhaps, quite intelligible, as here explained; when the explanation is not embarrassed by bringing under the notice of the student the multiple deviations, which furnish numbers not to be confounded with the equivalent numbers themselves. Still, it must be admitted that the equivalent numbers of two elements, as deduced from their combination with a third, are not always confirmed by their direct combination with one another. Thus, suppose we take the three elements, oxygen, hydrogen, and nitrogen, and, assuming oxygen at the weight of 8, combine it, in that quantity, severally with hydrogen and nitrogen in the smallest proportion. We thus get 1 for the equivalent of hydrogen, and 14 for that of nitrogen; and yet these elements combine in the ratio, not of 1 to 14, but of 3 to 14. Thus, we get 1 for the equivalent of hydrogen by the indirect method, and 3 for its equivalent, when deduced directly from its combination with nitrogen. Nevertheless, 1 and 14 are the recognised equivalents of hydrogen and nitrogen; though they are not found capable of forming a binary combination in that ratio. The reason why the indirect evidence, in this case, is preferred to the direct, is that many coincident determinations all concur in fixing the equivalents of hydrogen and nitrogen in the ratio of 1 to 14; while the fact that 3 and not 1 of hydrogen combine with 14 of nitrogen, is explained by assuming that hydrogen, in this instance, unites in a quantity which is a multiple of its equivalent by 3. Now, that this is the true view of the subject, may be more safely affirmed; because we are acquainted with a compound, in which hydrogen and nitrogen, associated, it is true, with another element, carbon, exist in the ratio of their equivalents; that is, in the ratio of 1 to 14. The compound, here alluded to, is hydrocyanic or prussic acid. If we could separate the carbon from this acid, without severing the union of its hydrogen and nitrogen, we should have a protohydruret of nitrogen, which would form a most interesting compound, should it ever be discovered.

In treating of the metals, which, including aridium and donarium,* are fifty-two in number, I shall dwell upon those that are employed in medicine, notice less in detail those used in the arts, and only enumerate the remainder as merely objects of philosophical curiosity. The metals officinal in the Pharmacopœia of the United States and in those of Great Britain, either in

* The claim of the substance, called donarium, to be a distinct metal, is doubted by some chemists.

the metallic state, or in combination, are eleven in number; namely, the two alkalifiable metals, potassium and sodium; the four earth-metals, calcium, magnesium, barium, and aluminium, and the eleven ordinary metals, iron, manganese, zinc, lead, tin, copper, bismuth, mercury, silver, antimony, and arsenic. A few other metals are occasionally used in medicine, and will be noticed more or less fully, according to their relative importance.

In treating of organic chemistry, it will be my aim to present principles. The facts will be arranged in classes, according to their several analogies, whereby the memory will be assisted in retaining them. This department of chemistry now forms a large domain, which is constantly increasing in extent; so great is the activity of the labourers in the field. In this part of my course, I shall have occasion to present to you, among other subjects, the organic neuter substances, which form the chief part of the food of animals; the alcohols and ethers, important as medicines and pharmaceutic agents; and the organic acids and alkalies. Among the organic alkalies are several invaluable medicines, which form a noble contribution of chemistry to the materia medica. Need I do more than name morphia and quinia, to recall to your recollection numerous instances of agonizing pain relieved, of violent disease arrested as if by a charm, and of valuable lives snatched from impending death?

In that division of organic chemistry which treats of animal substances, we have abundant proof of the great importance of chemical knowledge to the medical man. It is not necessary for our argument that we should contend that chemical laws are adequate to explain vital action. By no means; but we may justly claim for our science, that it sheds a flood of light on physiology and pathology, by the analyses it furnishes of the solids and fluids of the body.

I have thus, gentlemen, given you a sketch of the course I propose to deliver; connecting it with a few incidental remarks, intended to enforce the importance of chemical knowledge to the medical practitioner. On the subject of the medical applications of chemistry, much more might be said. Our science sheds important light on every department of medicine. It illustrates many difficult points of physiology, and forms the basis, in numerous instances, of physiological reasoning. It is indispensable in the elucidation of the functions of respiration and animal heat. It reveals to us, by analysis, the nature of the changes which the animal solids and fluids undergo in disease; and, by detecting pathological differences which otherwise elude our search, it aids materially in the diagnosis and treatment of many maladies. In this connexion may be mentioned the important aid furnished by chemistry, in pointing out the differences in urinary deposites and urinary calculi; and in discriminating the chemical peculiarities, exhibited by the blood, urine, and bile in different diseases. Besides these applications, it points out the various reagents proper for detecting poisons, teaches us what are the appropriate antidotes, and furnishes us with many of our most valuable remedies.

But, gentlemen, I am not willing to rest the claims of chemistry to your regard on its medical applications only, important as these certainly are. You are all destined to become members of a learned profession, and are bound to possess the knowledge that befits an accomplished gentleman. The applications of chemistry to the arts, therefore, deserve a share of your attention. A knowledge of these applications will tend to expand your minds, and liberalize your ideas. You are, no doubt, aware of the fact, that, of the members of the three learned professions, medical men have always taken the lead in the cultivation of the physical sciences. Meteorology is a science which belongs particularly to the physician to cultivate, on account of the marked influence which atmospheric changes exert on health and disease. Among the many arts which are conducted, for the most part, on chemical principles, may be mentioned metallurgy, or the art of working metals, glass and porcelain making, bleaching, dyeing, and calico-printing. Almost all colouring matters are products of chemical skill. The triumphs achieved by mechanical and chemical science are well fitted to give us exalted views of the power of mind over matter. The artificial light by which this room is now so brilliantly illuminated, reminds me of one of these triumphs. Our forefathers could scarcely have conceived it possible that an inflammable gas could have been substituted for lamps and candles; and yet this achievement of science has been realized in our day. The greater part of this large city is supplied by one manufactory of the gas; and while the chemist produces it in prodigious quantities, the mechanician conducts it, in nicely fitting tubes, to every point at which it is required. Gas for illumination has been successfully applied to the cooking of food; and I do not despair of seeing the day when it will be used to warm our houses.* The steam-engine moves, it is true, on mechanical principles; but the moving power, steam, depends, for its mechanical action, on its chemical relations to caloric. What shall I say, gentlemen, of the daguerreotype, by which an accurate picture is drawn, in a few seconds, by a pencil of light, guided by the hand of nature? Already has this wonderful invention been applied to the depicting of structure, both healthy and diseased, and with a fidelity that leaves nothing to be desired. But the most brilliant achievement of modern science is the electro-magnetic telegraph, which has truly annihilated both time and space. Just one hundred years ago, and near the spot where we are now assembled, the adventurous arm of an American drew down the lightning from the heavens, and proved its identity with the electric fluid; and, in our day, we find the same fluid made obedient to the will of man, as a means of communicating his thoughts, in an instant of time, to distant points of space. It causes a shudder to think of the danger incurred by the American philosopher in making his memorable kite experiment. To interrogate nature as to her operations in the very clouds—to invade the airy domain of the terrific lightning, was indeed a bold and sublime idea. Nor is the hazard, incurred under such circumstances, a mere matter of conjecture. The fate of Professor Richman, of St. Petersburg, who was instantly killed, in the midst of his family, while performing a similar experiment, attests the reality of the danger. This catastrophe, so memorable in the annals of science, is celebrated by Darwin in the following lines:—

"Nymphs! on that day ye shed from lucid eyes
Celestial tears, and breathed ethereal sighs!
When Richman rear'd, by fearless haste betray'd,
The wiry rod in Nieva's fatal shade;—

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* This lecture was first delivered in 1847.

Clouds o'er the Sage, with fringed skirts succeed,
Flash follows flash, the warning corks recede;
Near and more near he eyed, with fond amaze,
The silver streams, and watch'd the sapphire blaze;
Then burst the steel, the dart electric sped,
And the bold Sage lay number'd with the dead!"

In the foregoing remarks, gentlemen, I have endeavoured to convince you of the great importance of chemical science, both as a part of professional knowledge, and as an accomplishment. Will you allow me to indulge a hope that you are satisfied on these points; and that you will enter on its study with proper zeal? An eminent British philosopher, in a letter addressed to a friend of mine, expressed an ardent wish that magnetic observations might be conducted in China, and playfully asked whether it would not be possible to inoculate a mandarin with the magnetic virus, and thus spread the magnetic infection throughout the Chinese Empire. In the same spirit, gentlemen, allow me to inquire of you, whether it would not be possible to inoculate you all with the chemical virus. Indeed, I may truly say, that, ever since I have been a teacher of chemistry, I have endeavoured to perform this operation on my pupils, and though most of them have taken the genuine chemical disease, yet a few, I am sorry to say, have resisted all my efforts to impart the infection.

But to be serious, gentlemen, I shall take it for granted that you are satisfied by what I have said, that chemistry forms an indispensable part of a medical education. Indeed, I feel sure you will enter upon its study in the right spirit, and pursue it with zeal and perseverance. In my lectures I propose to present a methodical view of the science, proceeding carefully, step by step, from the known to the unknown, and adapting my instruction to the wants of those who have little or no previous knowledge of the science. As it may happen that I shall not always make myself understood in my public lectures, I invite my pupils to ask of me private explanations in regard to all points which may not be fully comprehended. It not unfrequently happens, that a few points of fact or of doctrine, misapplied or misunderstood by the student in the beginning, form, ever after, an obstruction to his progress. The chemical reading of the student, during his attendance on a course of chemical lectures, should be made subsidiary to the instruction, received from day to day in the lecture room. Instead of attempting to peruse chemical treatises regularly through, his daily reading should be on the topics which form the subject of each lecture. The interval between two courses of lectures, is the proper time for pursuing a systematic course of reading; and several approved works should then be carefully studied.

In conclusion, gentlemen, allow me to assure you, that you cannot be well qualified physicians without a knowledge of chemistry. As you are destined to become medical practitioners, Oh! think of the precious interests that will be confided to your care, and beware of taking charge of them without competent knowledge. Grant that your ignorance would not be detected by those who may confide in your skill; still, my young friends, could you conceal your incompetence from yourselves? Would your conscience let you rest, in view of your having trifled with the health and lives of your fellow-men? No, gentlemen, I cannot for a moment suppose that you will falter in the path of duty. You will, I am sure, resolve at once to make yourselves competent to perform the solemn duties which will devolve upon you as medical practitioners. You owe this resolution to your teachers, who will rejoice at your success, and feel mortified at your failure; you owe it to your friends and neighbours, who have a right to expect of you competent medical knowledge; you owe it to your country that protects you, and requires your talents in return; you owe it to near and dear relatives, who now anxiously watch your progress; and, above all, you owe it to yourselves as accountable beings to a Higher Power.